iology 103 N

Module 1

A. Introduction

Fundamentals of PLANT BIOLOGY

PREFACE

A. Purpose

The purpose of the module (interactive study guide) is as follows:

1. To introduce you to the biology of plant
2. To help you see the areas covered within each topic
3. To reinforce your learning.

B. Organization

This module contains the following elements: Topic outline, objectives, key terms, content, summary, references, review questions, activities/exercises and quizzes with answers.

C. How should the guide be used?

Consider this guide as an extension of your book in **Biology 103 N**. The book gives the formation for you to learn and the guide pave the way to learning and remembering the information. This guide must be used together with a book.

The following instructions will help:

1. Begin by reading the topic outline. This will help you see the overall organization of the module.
2. Now turn to the book. Read the topics given in the outline. Pick out the key terms, paragraphs and sections.
3. Sit back and think about what you read. Then write out the definitions of the key terms from memory.
4. Read the content found in the module.
5. Answer the review questions in the guide.
6. Use the guide as you listen to the lecture. Use the margins of the guide and jot down important ideas, definitions, etc that are presented or mentioned associated to the given figures/tables in the guide.
7. Do the activities/exercises that follow. Try your best to do the activity without being helped by anyone. Check your work. The answers are found at the end of the chapter. If you performed well (i.e. three or less mistakes) go to the next chapter. If you per formed low, review and reread the sections in the book that gave you difficulty.
8. Then answer the quiz at the end of the module. You should show improvement by this time (i.e. three or less mistakes).

Fundamentals of PLANT BIOLOGY

I. OUTLINE

A. INTRODUCTION

1. Plant Biology as a Science
    a. Early Botanical Study
        i. The Early Branches of Botany and the Persons Identified with Them
    b. Modern Botanical Study

2. Two Subdivisions of Plant Biology

3. Plant Classification: Kingdom Plantae

    a. Division Cholorophyta (Green Algae)
    b. Division Charophyta (Stoneworts)
    c. Division Phaeophyta (Brown Algae)
    d. Division Rhodophyta (Red Algae)
    e. Division Bryophyta (Mosses, Liverworts, Hornworts)
    f. Division Tracheophyta (Vascular Plants)

        i. Subdivision Psilopsida
        ii. Subdivision Lycopsida
        iii. Subdivision Sphenopsida
        iv. Subdivision Pteropsida
        v. Subdivision Spermopsida (Seed Plants)

            a) Class Pteridospermae (seed fern)
            b) Class Cycadae (Cycads)
            c) Class Ginkgoae
            d) Class Coniferae
            e) Class Gnetae
            f) Class Angiospermae

                1) Subclass Dicotyledoneae
                2) Subclass Monocotylidoneae

II. OBJECTIVES

Fundamentals of PLANT BIOLOGY

III. KEY TERMS

Fundamentals of PLANT BIOLOGY

IV. CONTENT

A. INTRODUCTION

1. Plant Biology as a Science

Plant biology is a science, traditionally called Botany. Botany comes from the Greek word "botane" which means plant. This word can be traced back to the Greek word "boskein" which means to graze. It is derived from the Greek word "bous" that means cattle. Thus etymologically, botany means the science of what cattle eat.

a. Early Botanical Study

It started as a practical study centered upon the importance of plants in human life as sources of food for nourishment, of fibers for clothing, of drugs for treatment of human diseases and of fuel. The study advanced to an intellectual interest such as satisfying curiosity about the world where human beings live. Then, man began seeking answers to questions such as. how are plants constructed; how are they nourished; and how do they grow and reproduce.

The study continued and became a science when facts were intelligently and logically organized. That is, by using the scientific method: observing, hypothesizing, experimenting, concluding, predicting, theorizing and making a natural law. It was only then, when the existence of natural laws was demonstrated and accurate prediction of effects from a given set of causes was-made.

i. The early branches of Botany and the persons that were identified with them :

1) Plant Taxonomy - the study of plant classification and relationship - Carolus Linneaus
2) Plant Morphology - the study of the plant structures -(this required little technical apparatus and the chief prerequisites were patience and painstaking observation and description). -
3) Plant Anatomy - the study of the finer details of plant tissue and cell structure - Nehemiah Grew, Robert Hooke, Marcelo Malpighi
4) Plant Physiology - the study of the plant's functional processes or any of its parts - John Ray, Von Helmont, Stephen Hales
5) Plant Pathology - the study of plant's diseases and their control
6) Plant Genetics - the study of plant's inheritance and variation-Gregor Mendel, Charles Darwin
7) Plant Ecology - the study of the relation of plants to their environmental conditions that affect their distribution and abundance
8) Plant Cytology - the microscopic study of plant cell structure and behavior

b. Modern Botanical Study

Botany came into its own as a Science, divorced from superstition and fantasy with the development of Chemistry, Physics and related sciences. Then, it developed slowly, plants were studied for their intrinsic interesting features of structure and behavior.

Now Plant Biology encompasses all aspects of plant life: from the molecular and structural organization, how energy is acquired, transferred and used; and basis of responses; to plant breeding, reproduction and survival.

2. Disciplines in Plant Biology

a. Taxonomic subdivision refers to the sciences that deal with particular group of plants, examples are: Botany - the study of plants
i) Bryology- the study of mosses, hepatics and liverworts
a) moscology- mosses
b) hepaticology-hepatics
ii) Pteridology- the study of ferns and its allies
iii) Phycology-the study of algae

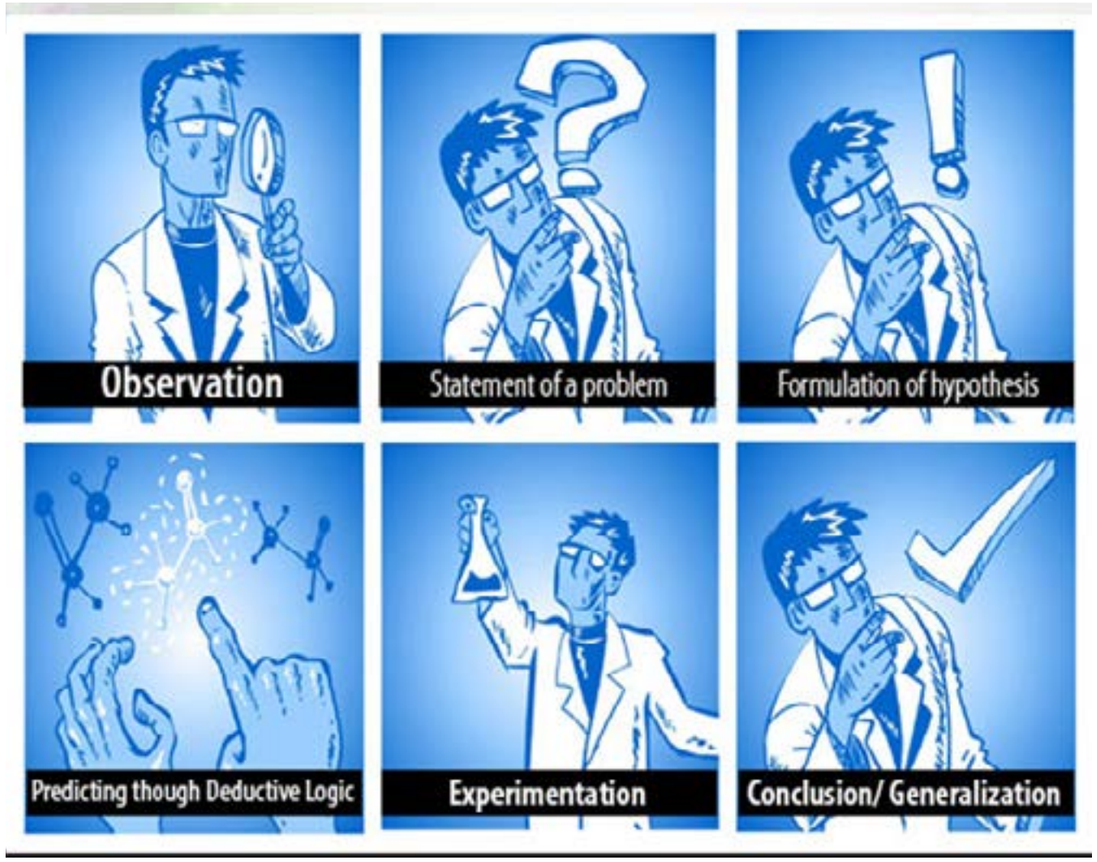
Fundamentals of PLANT BIOLOGY

b. Basic subdivision refers to the sciences that deal with the fundamentals common to all plants, examples are: Plant
i. Morphology- form, structure and development
a) Gross morphology- external structure
b) Histology- tissues
c) Cytology- cell structure and behaviour (now called cell biology which may also include molecular biology)
d) Embryology- progressive changes in the form and structure (from fertilization to birth- now called developmental biology)
ii. Physiology-functions and activities of plants and their parts including all physical and chemical processes.
iii. Genetics- heredity and variation, dealing with resemblances and differences of related plants resulting from the interaction of their genes and the environment.
iv. Systematics- kinds, diversity and similarities of plants, and their evolutionary relationships (Taxonomy- theory and practice of naming, describing and classifying plants)
v. Ecology- interaction of plants with one another and their environment affecting their distribution and abundance

c. Related Disciplines
i. Biochemistry- called biological chemistry, is the study of chemical processes within, and relating to, living organisms.
ii. Biophysics- interdisciplinary science using methods of, and theories from, physics to study biological systems.
iii. Biostatistics- application of statistics to a wide range of topics in biology.
iv. Bioengineering- application of concepts and methods of biology to solve real-world problems related to the life sciences and/or the application thereof, using engineering's own analytical and synthetic methodologies.
v. Biotechnology- the use of living systems and organisms to develop or make useful products, or any technological application that uses biological systems.
vi. Bioinformatics- the use of computer science, mathematics and information theory to model and analyze biological systems, specially systems involving genetic material.
vii. Agriculture- the cultivation of animals, plants, fungi, and other life forms for food, fiber, biofuel, drugs and other products used to sustain and enhance human life.
viii. Medicine- practice of the diagnosis, treatment, and prevention of disease.
ix. Medical Technology- subset of health technology, encompasses a wide range of healthcare products and is used to diagnose, monitor or treat diseases or medical conditions affecting humans.
x. Nursing- health care sector focusing on the care of individuals, families, and communities so they may attain, maintain, or recover optimal health and quality of life.
xi.) Forestry- the science and art of creating, managing, using, conserving, and repairing forests and associated resources to meet desired goals, needs, and values for human benefit.
xii. Pharmacology - the science of drugs including their origin, composition, properties, interactions, toxicology, therapy: pharmacokinetics, the movement of the drugs within the organism's body; pharmacodynamics- the effect of the drugs on living organisms; and medicinal uses.

d. Scientific Method and its Limitations

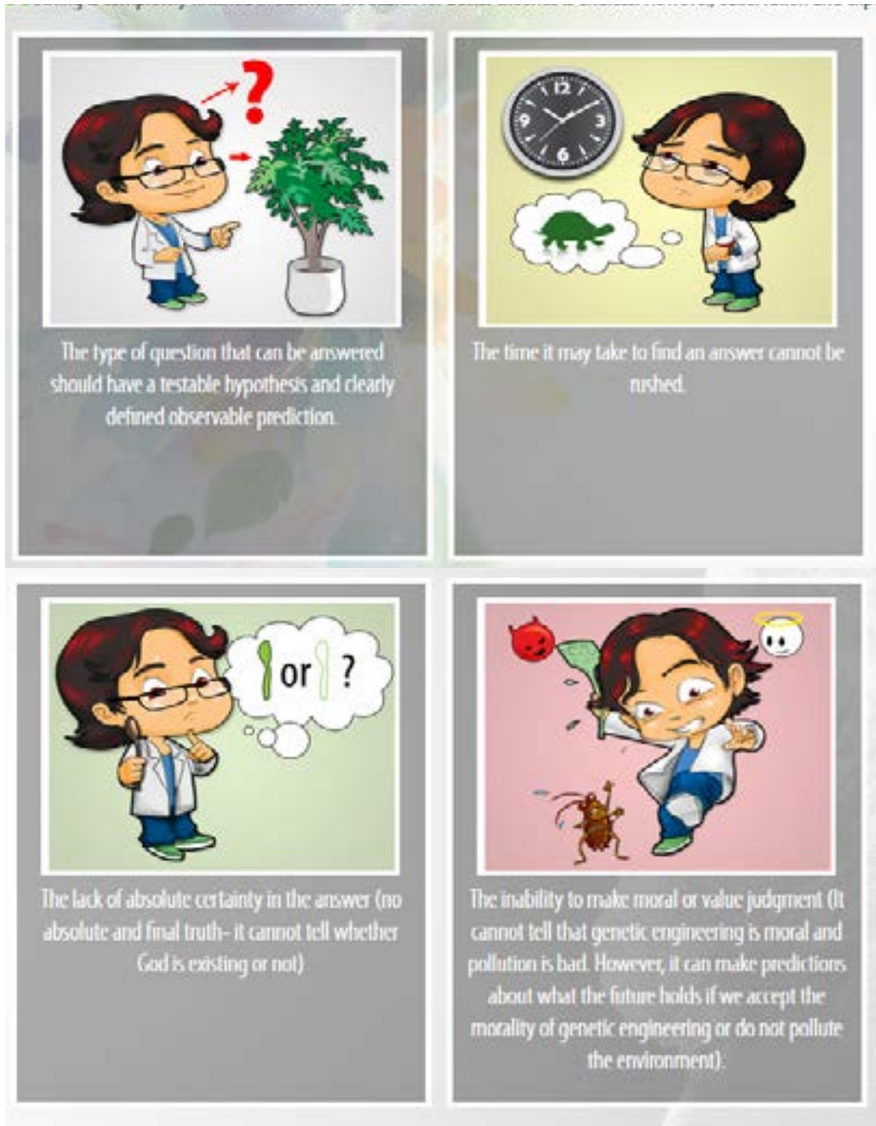
1) Steps



Fundamentals of
PLANT BIOLOGY

2) Limitations

Nothing is completely finished in science: the search for better theories is endless. However, observation and experimentation limit the application of the scientific method. Certain concepts exist for which the scientific method is inappropriate.



e. Life, Some theories on the origin of life and Evolution of plants

a. Special creation- life began as a special act of God

b. Panspermia- life originated elsewhere in the universe and travelled through space to colonize the earth.

c. Spontaneous generation- certain living things arise from non-living things such as that of:

1. Aristotle's view (384-322 BC)- maggots were naturally produce from meat left out in the open and puddles or muddy water could bring forth frogs. Scientists who showed that the interpretation of spontaneous generation by Aristotle was not valid included:

i. Francesco Redi (1628-1697)- experimented two pieces of meat: one covered and one uncovered- result: maggots appeared on the uncovered and no maggots on the uncovered meat.

ii. Anthony van Leeuwenhoek (1632-1723)- contributed single lens microscope that helped Joblet, Needham and Spallanzani to examine boiled and not boiled broth.

iii. Louis Pasteur (1822-1895)- experimented on flask with long sine curve neck which end was left open. Microorganisms on dust particles settled in the bottom of the curved neck and could not reach the boiled broth inside the flask: the broth remained clear. When the neck was broken near the top of the flask, dust particles settled directly into the broth, making it turbid with microorganisms.

Oparins view (1894-1980) (Russian biochemist in 1936)-
theorized the chemical evolution theory which states that conditions on earth were quite different when living systems were being formed. Atmosphere very likely may contain little oxygen, rich in ammonia, methane, and hydrogen. Organic compounds from which contemporary life is built were produced by the energy of sunlight, electrical discharge, and volcanic heat acting on these components of the primitive atmosphere. This is known as coacervate theory. This idea was conceptualized based on the clay pot theory. Sydney Fox (1912-1998) theorized the clay pot theory. It states that low concentrations of organic molecules in the soupy seas are pushed onto the shore into basins of water where the water is evaporated by heat. What is left is the high concentration of organic molecules, cell like structure called proteinoid microspheres.

In support of these views, in 1953, 30 years after the Oparin's view was known, Stanley Miller (1930-2007) subjected four gases: hydrogen, methane, ammonia and water vapour to the energy of an electric spark and circulated the mixture in a closed system. He succeeded in producing several organic compounds including amino acids (nitrogen containing organic building blocks of proteins) put forth the theory of abiogenesis. However, neither purines and pyrimidines (essential constituents of the building blocks of proteins) nor other heterocyclic/aromatic compounds were formed. Certain conditions must be met in order for chemically complex entities to be formed.

Vitalists have looked forward to the day when science may actually create a "living" thing from simple chemicals. They claim that rightly so, that even if such a man-made life form could be created, this would not prove that natural life forms may have developed by a similar chemical evolutionary process. The scientists understand this and plod on testing theories.

Fundamentals of
PLANT BIOLOGY

3. Plant Classification

Kingdom Plantae

Division Chlorophyta- Green algae (7,000): Chlamydomonas, Volvox, Ulothrix, Spirogyra, Oedogonium, Ulva
Division Charophyta- Stoneworts (300): Chara, Nitella, Tolypella

Division Phaeophyta- Brown algae (1,500): Sargassum, Ectocarpus, Fucus,
Laminaria

Division Rhodophyta- Red algae (4,000): Nemalion, Polysiphonia, Dasya, Chondrus, Batrachospermum

Division Bryophyta

Class Hepaticae- Liverworts: Marchantia, Conocephalum, Riccia, Porella
Class Anthocerotae- Hornworts: Anthoceros
Class Musci -Mosses: Polytrichum, Sphagnum, Mnium

Division Tracheophyta

Subdivision Psilopsida-Psilotum, Tmesipteris
Subdivision Lycopsida-Club mosses (1,500): Lycopodium Phylloglossum, Selaginella, Isoetes, stylites
Subdivision Sphenopsida-Horsetails (25): Equisetum
Subdivision Pteropsida- Ferns (10,000):Polypodium, Osmunda, Dryopteris, Botrychium, Pteridium
Subdivision Spermopsida, Seed plants Class Pteridospermae seed ferns extinct

Class Cycadae- Cycads (100): Zamia
Class Ginkgoae -(1) Gingko
Class Coniferae- Conifers (500): Pinus, Tsuga, Taxus, Sequoia
Class Gneteae (70)- Gnetum, Ephedra, Welwitschia

Class Angiospermae Flowering Plants

Subclass Dicotyledoneae- Dicots, (225,000): Magnolia, Quercus, Acer, Pisum, Taraxacum, Rosa, Chrysanthemum, Aster, Primula, Ligustrum, Ranunculus
Subclass Monocotyledoneae -Monocots (50,000):Lilium, Tulipa, Poa, Elyiriys, friticum, Zea, Ophrys, Yucca, Sabal

V. SUMMARY

Plant Biology is human activity directed towards discovering new knowledge about plants. It is traditionally divided into two subdivisions: basic division- concerned with fundamentals common to all life (such as: molecular biology, genetics, taxonomy, ecology, physiology and morphology) and taxonomic division- dealing with particular groups of plants.

Biological knowledge is a product of a process, of formulating and testing hypothesis known as scientific method. This involves five steps:
1. Observation;
2. Asking question;
3. Hypothesis;
4. Prediction
5. Experimentation and
6. Generalizationz (analysis, evaluation and conclusion).

These six steps provide evidence or proof to support a theory or a law and not a proof of truth. 1. Experimentation limits its application. There are four kinds of limitations:

1. The type of questions that can be answered;
2. The time it may take to find an answer;
3. The lack of absolute certainty in the answer; and
4. Inability to make moral or value judgments.

The following are some theories that explain the origin of life: special creation, panspermia and spontaneous generation (as interpreted by Aristotle and Oparin).

Plant Biology is the scientific study of plant life. All that is known about life is its manifestations.
Every living organism has a number of properties that help us characterize it as living.

These are: 1. Non-random organization; 2. Metabolism (summation of all processes that include: assimilation; energy acquisition and transformation that make energy available for movement, responsiveness, adaptation and growth; and 3. Reproduction. Development and evolution are features also associated with all life forms.

VI. REFERENCES

Fundamentals of
PLANT BIOLOGY

VII. REVIEW QUESTIONS

A. Biology is not a loose collection of unrelated disciplines called : ecology, cell biology, genetics and so forth. It is to a large measure an integrated sciences. Group the branches of biology into two subdivisions and list also some disciplines related to biology.

B. The process of obtaining information by using the senses is called a_____.
A) conclusion B) inquiry C) scientific method D) observation

C. What step limits the application of the scientific method?
A) observation B) formulating a hypothesis C) formulating a problem D) prediction

VIII. EXERCISES

In 1838, the German Botanist Mathias Schleiden, after examining the tissues of many plants under a microscope concluded: All plant tissues are composed of individual cells. This form of reasoning, from specific observation to general conclusion is called _____ logic. The opposite process, going from a general conclusion to a specific consequence, is called _____ logic. Had Schleiden said, "if all plant tissues are composed of individual cells, then the tissues of ferns must be composed of individual cells" he would have been making a _____ using _____ logic.

Fill up the table showing the steps employed in the scientific method.

STEPS DESCRIPTION

STEPS	DESCRIPTION

Why are observations from the natural world essential to a scientific method?

Miller's classic experiment demonstrated that a discharge of sparks through a mixture of gases could result in the formation of a large variety of organic compounds. Miller used all of the following gases in his experiment EXCEPT:
A. Methane C. Water
B. Ammonia D. Oxygen

Who synthesized proteinoid microspheres in the laboratory using an apparatus that mimicked the early earth?
A. Haldane C. Urey
B. Fox D. Miller
E. What are the minimum requirements to be living?

This can be answered by completing the table below.

Identify the property (characterize all living things)	Definition of the property	Cite 2 aspects (meaning) of each property	Give the significance of the property to the continuity of life

Fundamentals of

PLANT BIOLOGY